What is claimed is:

1. A process for localized repair of a turbine component having a surface with a damaged thermal barrier coating system comprising the steps of:

cleaning a spalled region of the exposed surface of the component;

texturing the exposed surface to produce a textured surface having an array of spaced grooves of predetermined groove spacing, predetermined groove geometry, and predetermined wall angle with the exposed surface; and

depositing a replacement thermal barrier coating over substantially only the textured surface.

2. The process of claim 1 wherein the step of texturing the exposed surface includes impinging a high energy beam on the exposed surface to produce the array of spaced grooves of predetermined groove spacing, predetermined groove geometry and predetermined wall angle with the surface.

3. The process of claim 2 wherein the step of texturing the exposed surface with a high energy beam includes impinging an electron beam on the exposed surface.

4. The process of claim 2 wherein the step of texturing the exposed surface with a high energy beam includes impinging a laser beam on the exposed surface.

5. The process of claim 4 wherein the step of texturing the exposed surface by impinging a laser beam further includes impinging a laser selected from the group consisting of YAG lasers, excimer lasers, diode lasers and YAG-harmonic wavelength lasers.

6. The process of claim 5 wherein the step of texturing the exposed surface by impinging a laser beam further includes impinging a laser beam having a power level of up to 1 KW.

7. The process of claim 6 wherein the step of texturing the exposed surface by impinging a laser beam from an excimer laser further includes impinging the beam at a power level of between about 25 to 40 watts and at a beam traverse speed of about 2 inches per minute to about 15 inches per minute.

8. The process of claim 1 further including the step of blending the deposited thermal barrier coating with adjacent undamaged thermal barrier material to obtain a smooth transition.

9. The process of claim 1 wherein the step of cleaning further includes selecting a cleaning method from the group consisting of grit blasting, vapor degreasing, alkaline cleaning and vapor honing.

10. The process of claim 1 wherein the groove spacing is from about 1 mil to about 8 mil.

11. The process of claim 1 wherein the groove geometry includes unidirectional grooves.

12. The process of claim 1 wherein the groove geometry includes at least two sets of grooves, the grooves within each set being substantially parallel with one another, and the grooves of each set intersecting the grooves of another set of grooves an angle in the range of about 15° to about 90°.

13. The process of claim 1 wherein the groove geometry includes a groove depth that does not exceed the thickness of the deposited ceramic material.

14. The process of claim 2 wherein an incidence angle of the high energy beam with the surface is between about 0° and 75° relative to a plane normal to the surface to produce grooves having predetermined wall angles of between about 15° and 90° with the surface.

15. The process of claim 1 wherein the step of cleaning the exposed surface of the component includes cleaning an exposed surface substrate.

16. The process of claim 15 wherein the step of texturing the exposed surface of the component includes texturing the exposed surface substrate.

17. The process of claim 15 wherein the step of depositing a replacement thermal barrier coating over substantially only the textured substrate further includes first depositing a bond coat over the textured substrate without concealing the texturing, the followed by depositing a ceramic layer over the bond coat.

18. The process of claim 15 further including the additional step of depositing a bond coat over the exposed surface substrate.

19. The process of claim 18 wherein the step of texturing includes texturing the deposited bond coat.

20. The process of claim 18 wherein the step of depositing a replacement thermal barrier coating over substantially only the textured bond coat.

21. The process of claim 1 wherein the step of cleaning the exposed surface of the component includes cleaning an exposed bond coat layer.

22. The process of claim 21 wherein the step of texturing the exposed surface of the component includes texturing the exposed bond coat layer.

23. The process of claim 22 wherein the step of depositing a replacement thermal barrier coating over substantially only the textured substrate further includes depositing a ceramic layer over the bond coat.

24. A process for localized repair of a turbine component having a surface with localized damage to thermal barrier coating system in which the ceramic top coat has spalled, exposing an underlying bond coat, comprising the steps of:

cleaning the exposed bond coat;

machining the exposed bond coat using a high energy beam to produce a substantially linear array of substantially equally spaced grooves intersecting at an angle of between about 15° to about 90° and spaced about 1mil to about 5 mil, the grooves being no deeper than the thickness of the bond coat and formed by a high energy beam incident at an angle of about 0° to about 75° normal to the surface of the bond coat; and

depositing the ceramic material on the machined bond coat.

25. The process of claim 24 further including the additional step of masking the surfaces of the component adjacent to the exposed bond coat.

26. The process of claim 24 further including the additional step of blending the deposited ceramic material with the adjacent surfaces of the component following repair to maintain surface uniformity and smoothness.

27. A turbine component having a surface with a thermal barrier coating system with a localized repair made by the process of claim 1.